



## Recent results of multilayer MoSi coatings on EUVL substrates

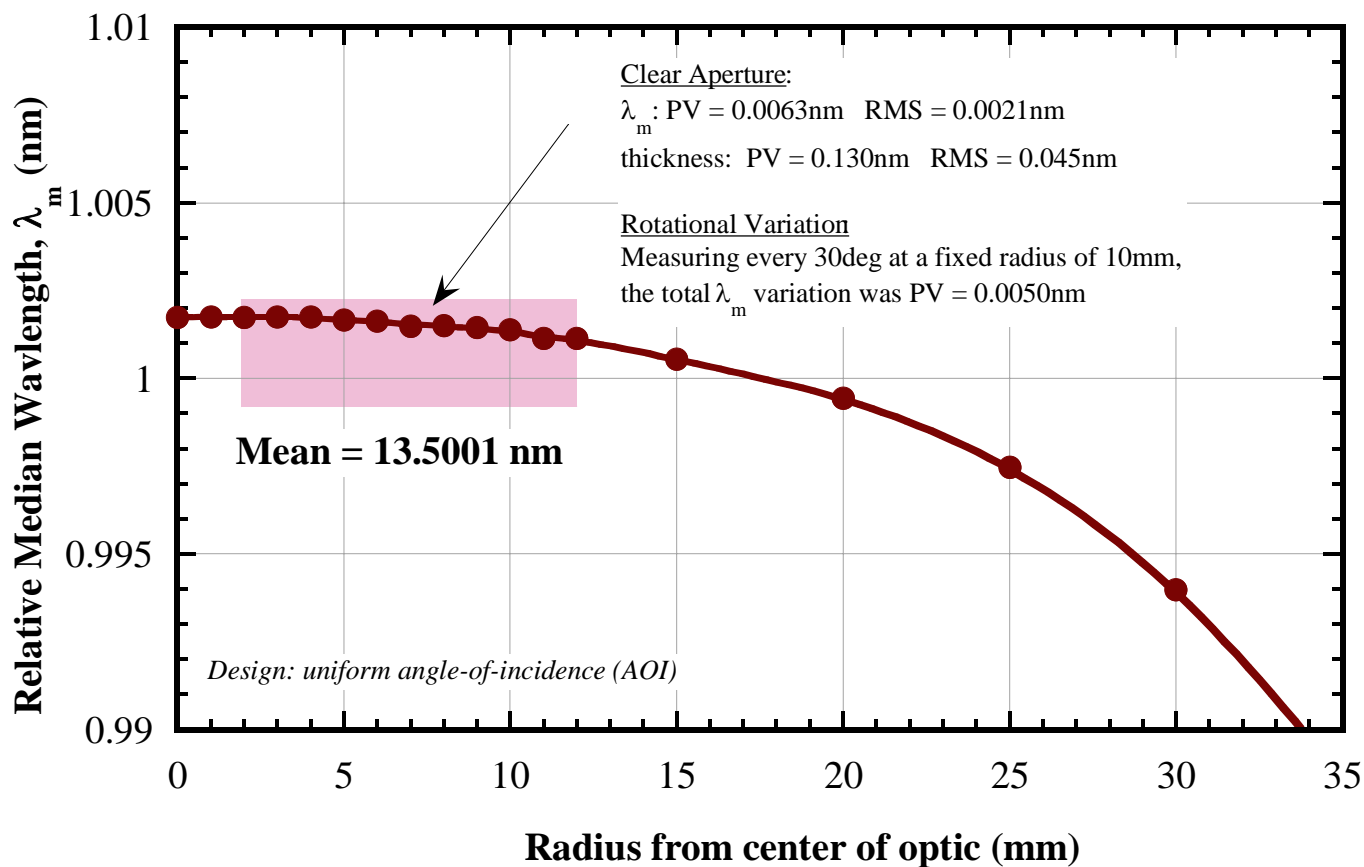
**Michael D. Kriese, Yuriy Y. Platonov, Yaniv Barad & Charles Tarrio**

**We present results and analysis of multilayer MoSi coatings on various convex and concave optics recently coated for the EUVL industry. Most results pertain to uniform distributions of coating period. In some cases, the optic has a prescribed radial variation of angle-of-incidence that must be matched by radial variation of the coating period to target a fixed median wavelength of 13.5nm for the EUV reflectivity. Measurements were performed by the NIST/DARPA EUV Reflectometry Facility and Center for X-Ray Optics at Lawrence Berkeley National Laboratory. Additionally, the results of two corrective procedures are included, namely wet-etch coating removal for recoating, and overcoating to shift the median wavelength with minimal impact to peak reflectivity and full-width (applicable to coatings with a small number of periods).**

**Osmic is also upgrading the Inline Deposition machine for spinning, to further improve our capability and capacity for EUVL optics.**

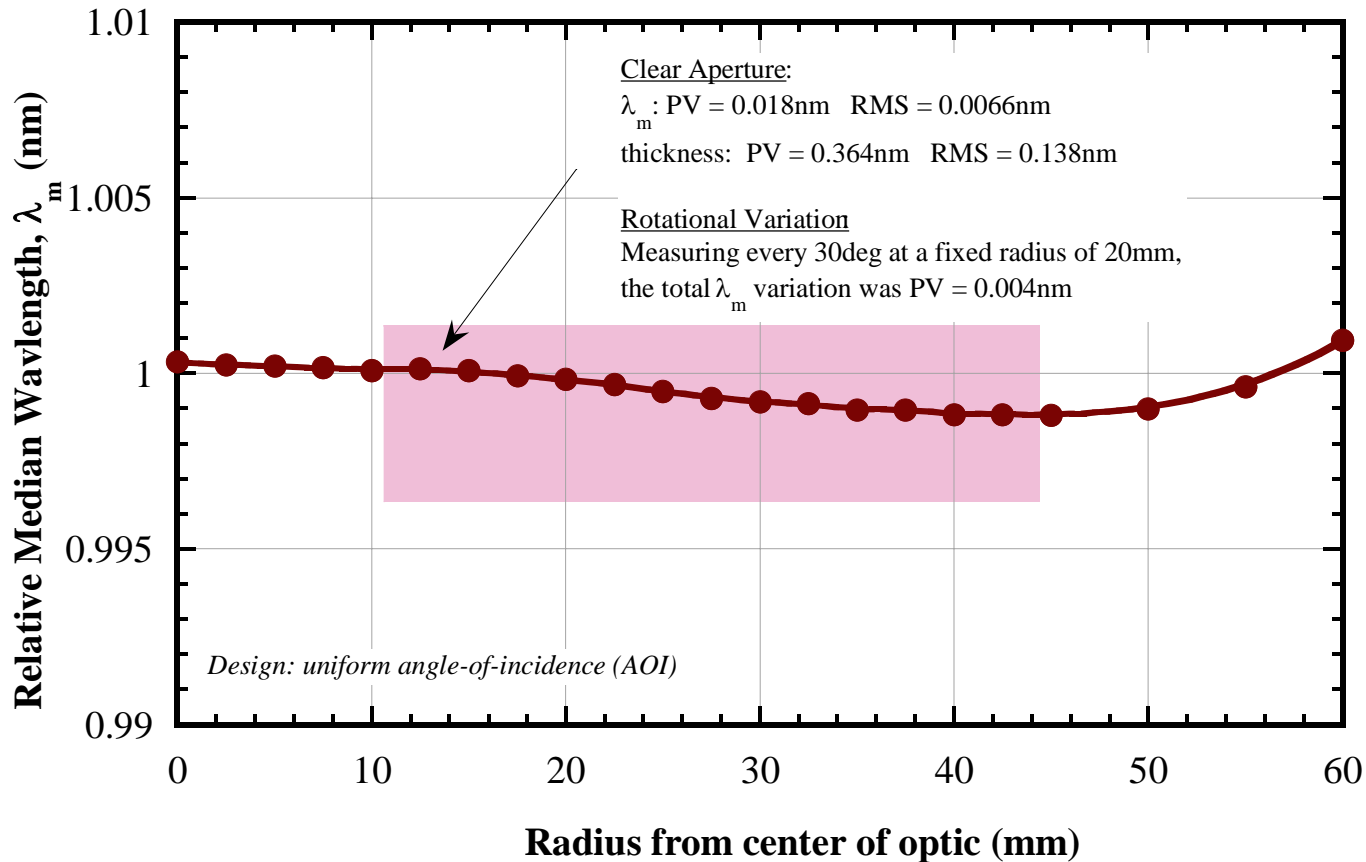
# Peak Wavelength - I

## Radial Variation of Median Wavelength, ~215nm Convex

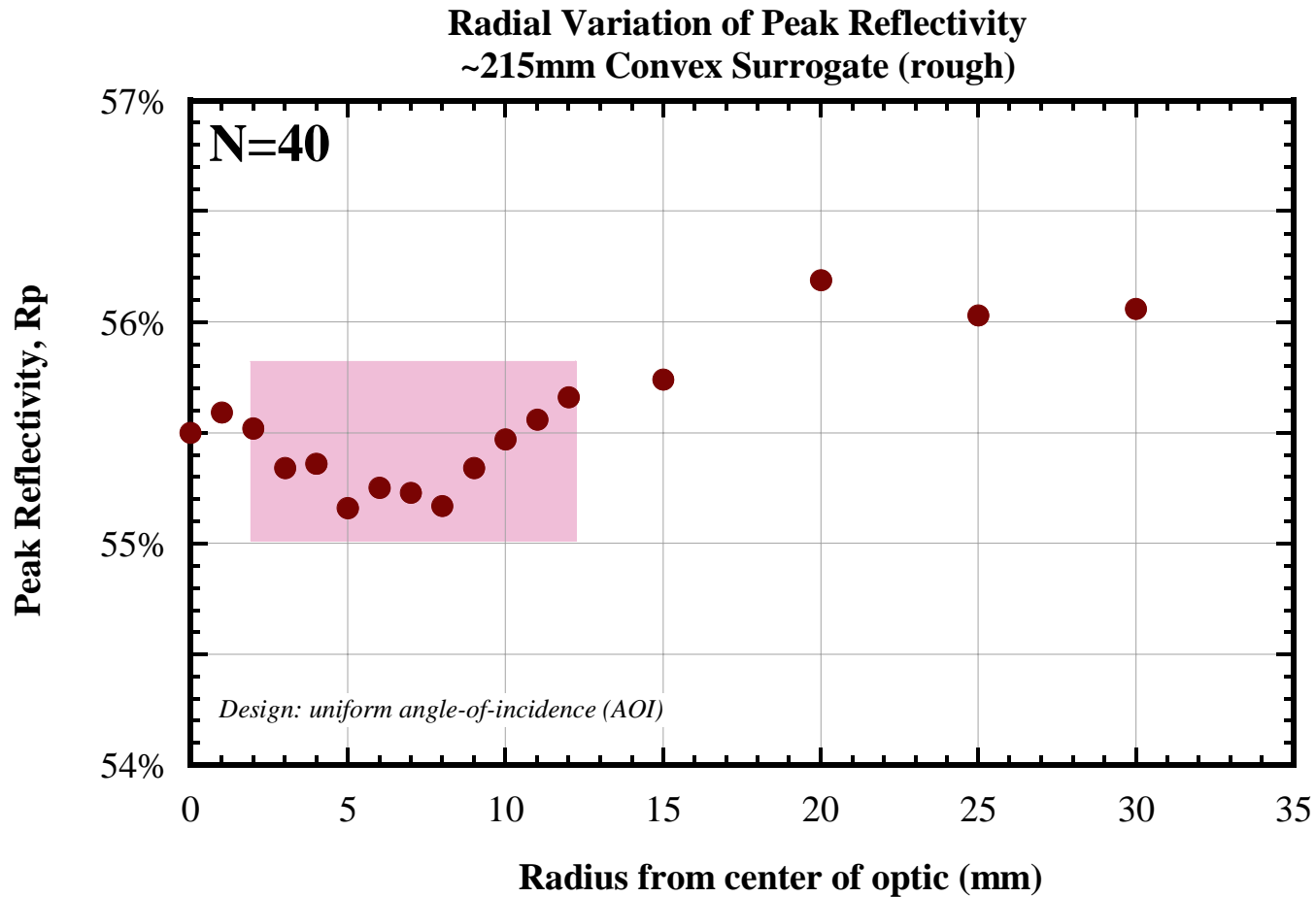


# Peak Wavelength - II

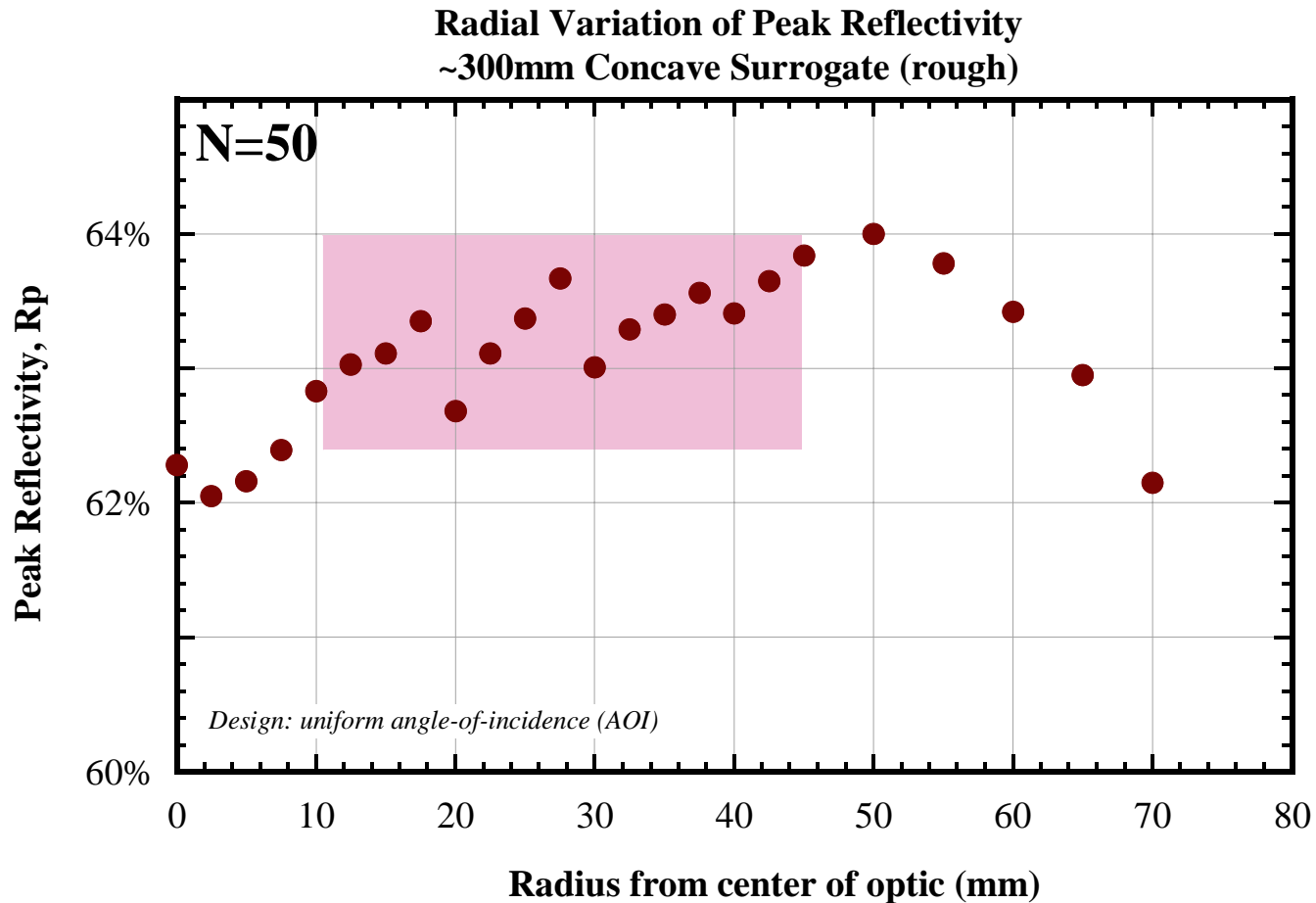
Radial Variation of Median Wavelength, ~300mm Concave



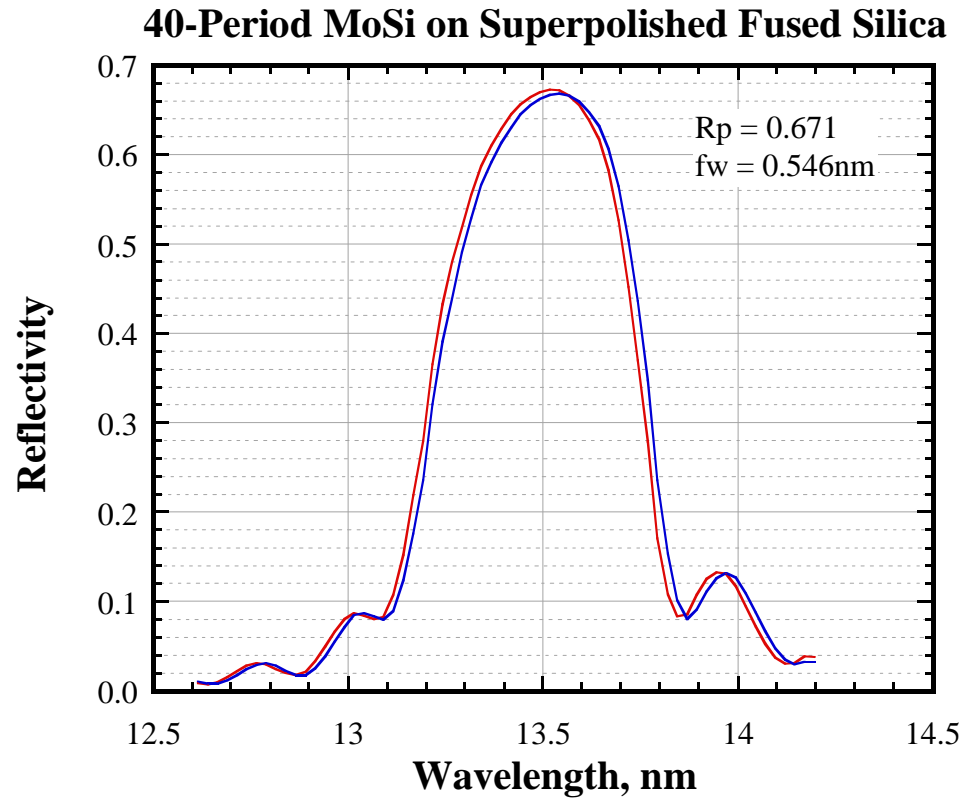
# Peak Reflectivity - I



# Peak Reflectivity - II



# Peak Reflectivity - III



# Wet Chemical Stripping - I

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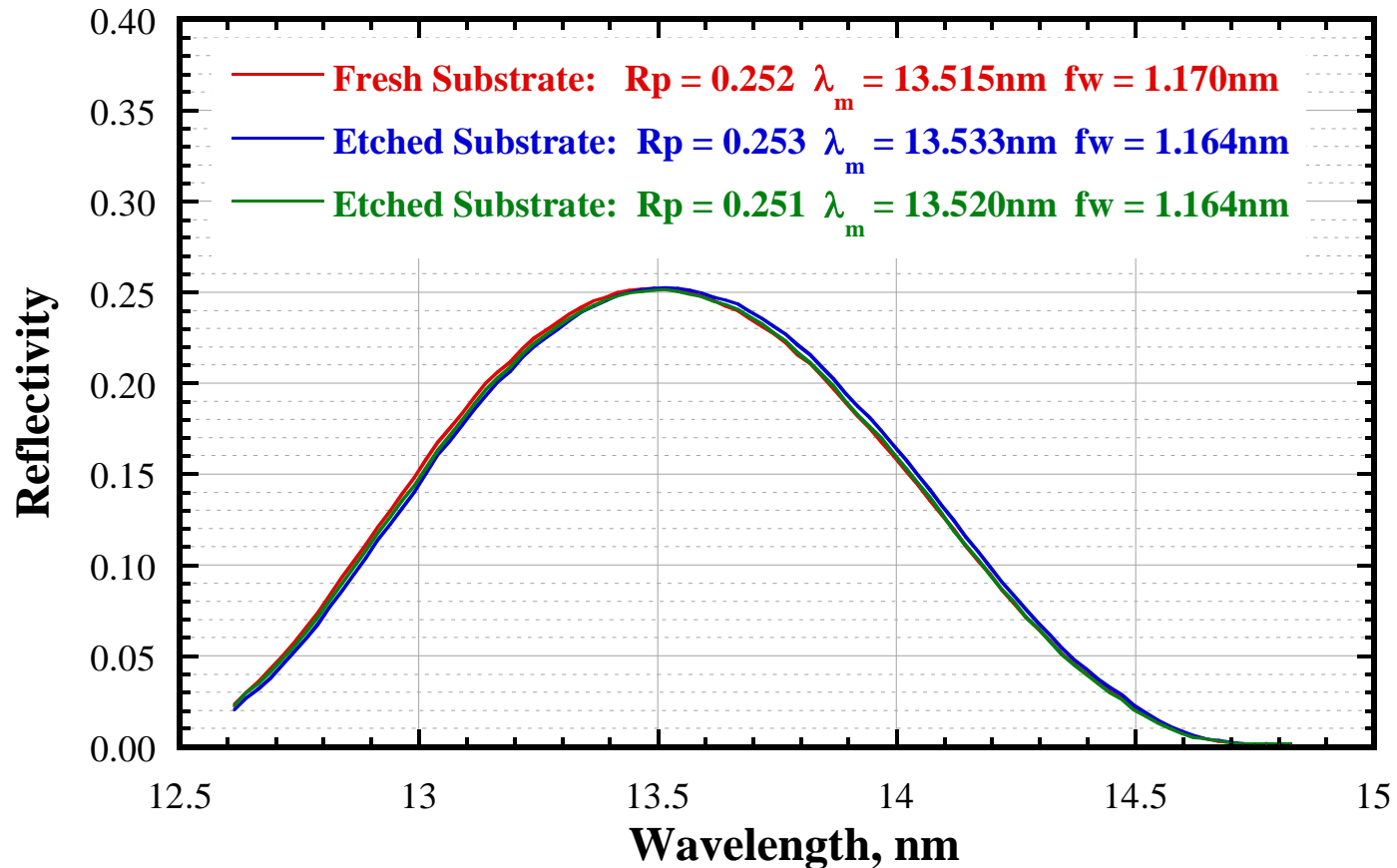


Osmic has used a wet chemical process to strip unsatisfactory coatings from small surrogates, and recoated them, in most instances with very little impact to the performance as measured by peak reflectivity & full-width at half maximum.

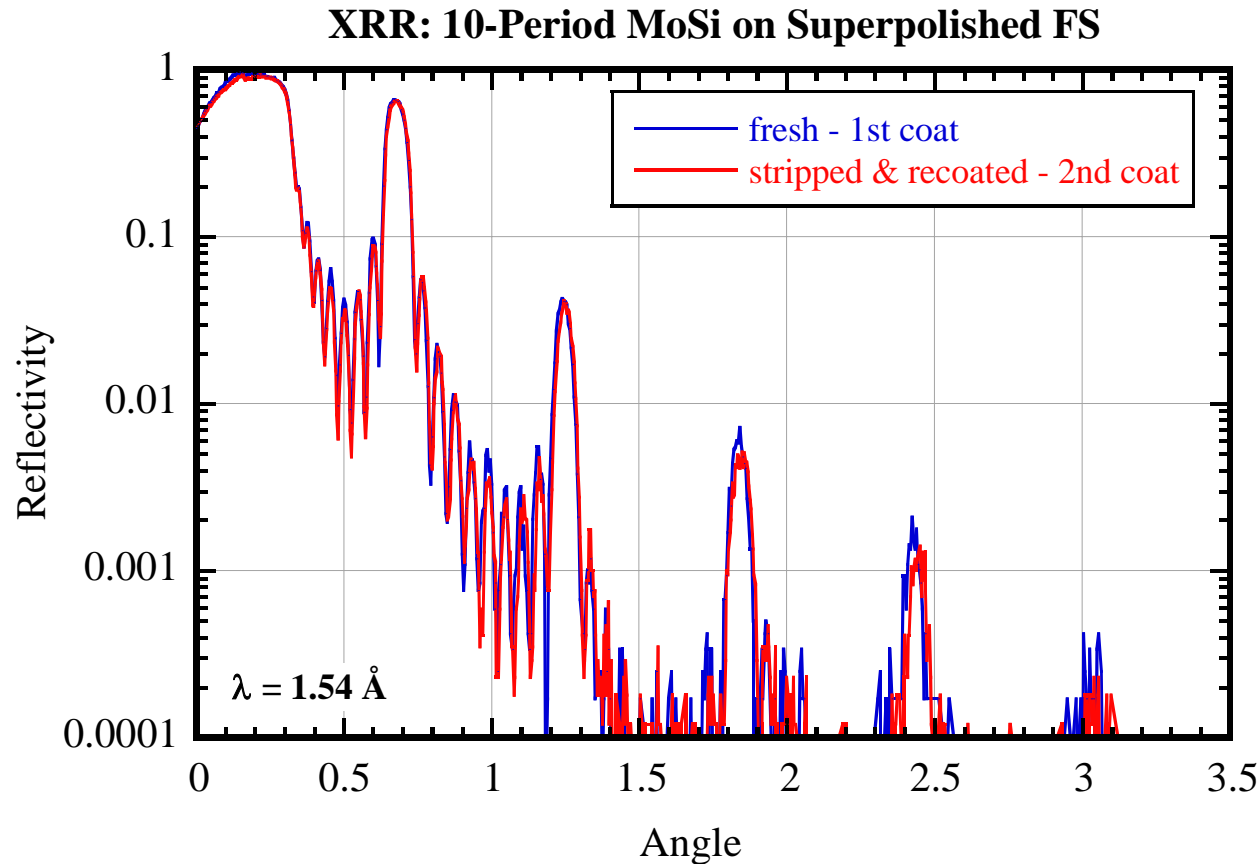
Following are various results achieved.

# Wet Chemical Stripping - II

## 10-Period MoSi on Superpolished Fused Silica



# Wet Chemical Stripping - III



# Overcoat Correction - I

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For EUVL coatings that require only a small number of layer-pairs, it is possible to make corrections to the peak wavelength position with minor impact to the reflectivity peak height and width. Osmic has evaluated this both experimentally and theoretically.

$\Lambda_N$  = actual period of the base coating

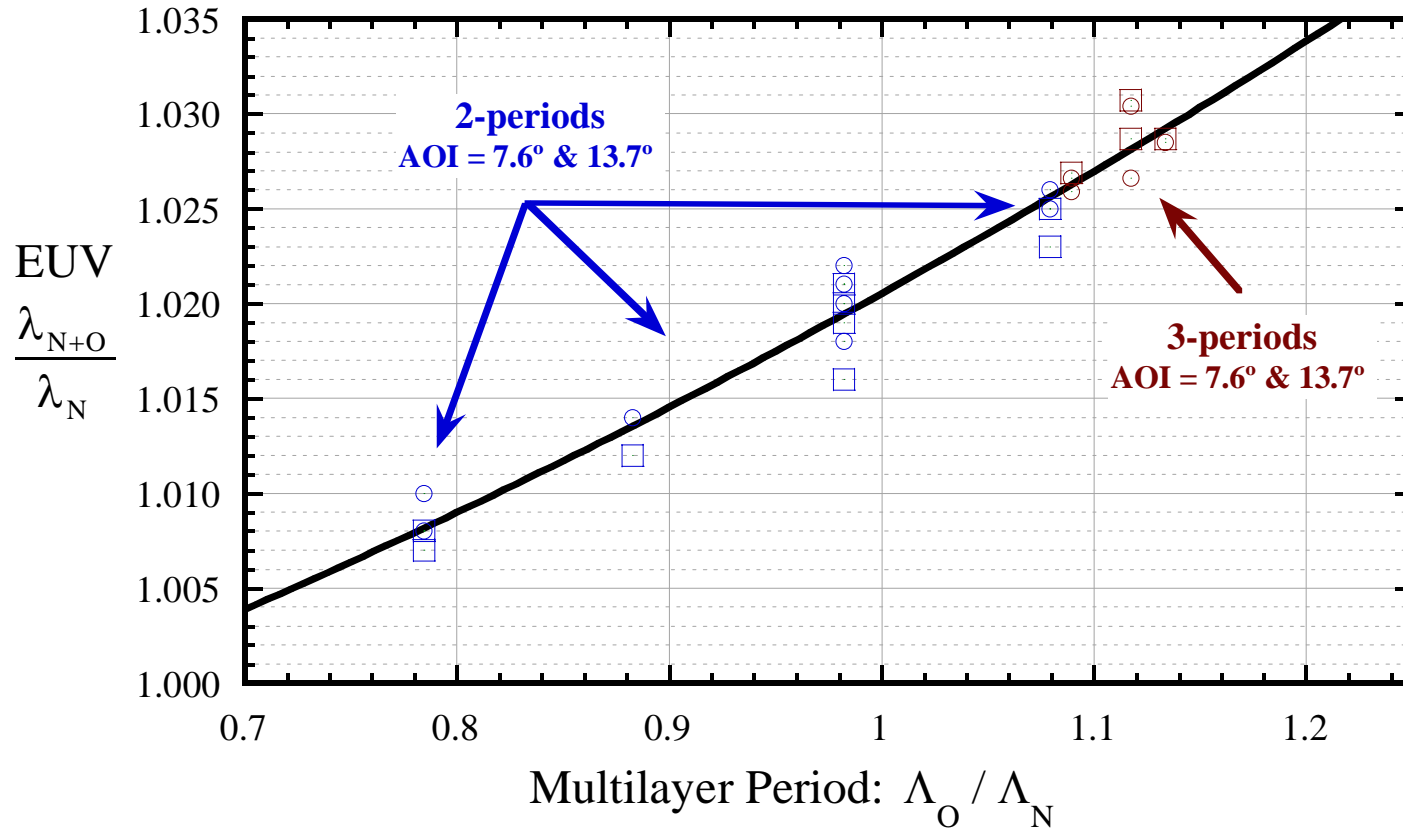
$\Lambda_O$  = period of the overcoat

$\lambda_N$  = peak position of the base coating

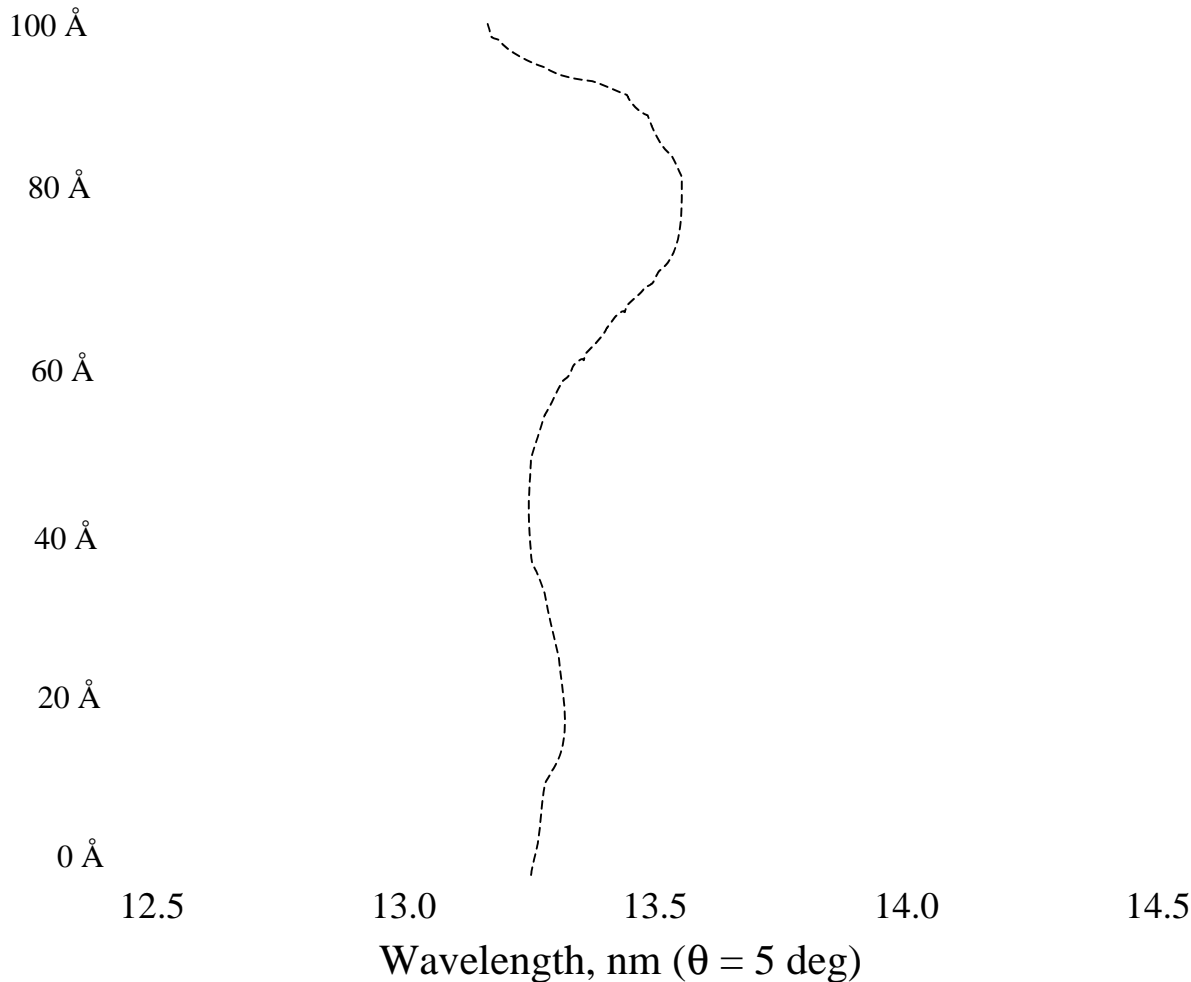
$\lambda_{N+O}$  = peak position of the overcoated coating

# Overcoat Correction - II

Shift in Peak Position depends on Relative Period



# Overcoat Correction - III



IMD Computation of Reflectivity – reflectivity peak is horizontal tangent to the contours (dashed line).

Shown is the effect of increasing overcoat period of a 2-period overcoat onto a 10-period base ( $\Gamma=0.4$ ).

*A 15Å layer of hydrocarbon is sandwiched between the “base” coating & overcoating.*

# Acknowledgements

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- **Exitech Ltd. of Oxford, UK**